Exploring the Effectiveness of Applying Multimedia in Supporting Instruction and Learning in a General Engineering Education Course in Taiwan

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Abstract

This study applied multimedia into a general engineering course in Taiwan and attempted to evaluate the effectiveness of multimedia-assist instruction and learning. The course was designed for undergraduate students with variety of nationality, which introduced new technology development and achievements of Taiwan industries and research institutes from a historical approach. The contents included integrated circuit related industry, display industry, computer and information technology industry, nano and biomedical technology, agriculture and ecological research, and traditional industry transformation development in Taiwan that all have significant achievements in the world. During each class meeting, one or two technological topics were lectured accompanied with a 30-minutes multimedia video that presented relevant contents to enhance students understanding of the issues. All the videos were also mounted onto the course website for students to review after class. Research data were collected from 45 male and 9 female students and who came from different countries. Results showed that multimedia videos can help arouse their awareness of learning issues in the area improve students' understanding of contents, and the depth of their learning in the course. Almost all students liked the approach of using multimedia to assist teaching and learning; and they preferred this approach over traditional lecture-based instruction. And they would recommend this course to peers, too. Moreover, Students' degree of engagement would cause the variance of students' perceived helpfulness of video assists their learning in the general engineering education course. Finally, this study also proposed suggestions to both design and research in applications of multimedia enhanced learning in engineering education

Introduction

In an era of unprecedented technological advancement, engineering practice continues to evolve, however, engineering education, containing and emphasizing science and mathematics based-subjects, has not changed appreciably (Ang, Cruse, McVey& McMasters, 1999). It has been content-centered and design-oriented (Bourne, Harris & Mayadas, 2005), and often demands multi-disciplinary knowledge and skills. The Accreditation Board for Engineering and Technology (ABET) Engineering Criteria 2000 emphasizes outcomes over process, and provides an opportunity for stakeholders to help universities define educational goals and objectives and design a curriculum to meet the desired outcomes of technology advanced (Ang, Cruse, McVey& McMasters, 1999). Although many researches had explored different approaches to improve engineering education, yet more perspectives could be added to expand the possibilities of promoting engineering training. For example, general education could be an important context to engage students from non-engineering majors in engineering learning, or even to motive these students for advancing learning in engineering. There have been many courses offered in general education that present more basic knowledge of science, technology and engineering or introduce technology development involving engineering methods and techniques that intend o help students from different disciplines learn about engineering. However, not much research had paid enough attention to this approach for examining its effectiveness or ways to enhance learning engineering in general education course.

On the other hand, in recent practice of engineering education, there are more and more teachers apply multimedia to support their teaching, such as nanotechnology (Yueh & Sheen,2009), bioscience (Mutharasan, Magee & Wheat-

ley, 1997), circuit and electronic (Maby, Carlson, Connor, Jennings& Schoch, 1997), computer and information science(Lang, Cruse, McVey& McMasters, 1999; Kartam & Reshaid, 2002) and so on. Multimedia is a technology for presenting material in both visual and verbal forms; it can combine verbal material such as printed and spoken text and visual material such as pictures, graphs, photos, dynamic graphics and so on (Mayer, 2001). Multimedia has the potential of creating high quality learning environment. It can enable teachers to choose from a range of media elements to convey a particular message (Cairncross & Mannion, 2001), illustrate spatial relationships (Sutcliffe & Faraday, 1994), and present different information toward different kinds of learners (Douglas,1993). When using multimedia in support of learning, it not only can help learners to recognize and retention the presented material but also to construct a coherent mental representation from presented materials (Mayer, 2001). It can further promote the depth of students' learning to specific issue and engage students in a way that static material does not (Cairncross & Mannion, 2001). Besides, Kim, Liu, & Bonk (2005) proposed that students°Ø different degree of engagement of learning would also affect their attitude toward learning. How to use multimedia to effectively engage students in learning engineering is also an important research issue in engineering education.

As a key player in world-wide technology industry, Taiwan government has been paying great attention to advance engineering education especially in higher education. Aside from many education programs for cultivating human resources in specific fields such as nano-technology, image and display technology, bio-medicine technology, there is another call for promoting science, technology and engineering in university general education. Besides, National Applied Research Laboratories (NARL), established in 2003 aimed to build up research and development platforms to support academic research, promote frontier science and technology, and foster high-tech manpower in Taiwan. This institute had produced a series of videos to introduce Taiwanese advance science and technology such as circuit related industry, display industry, computer and information technology industry, nano and biomedical technology, agriculture and ecological research, and traditional industry transformation development in Taiwan. To explore the effectiveness of applying multimedia in general engineering education, this study reproduced the videos release from NARL, integrated them into classroom teaching to provide students with the basic understanding of the technological development and outcomes of Taiwan. And an evaluation study was conducted to collect students' attitude toward video-assisted instruction and their perception of the helpfulness of this approach on their learning.

Method

Context

This study was implemented in a university general engineering education course offered in fall semester of 2008 in Taiwan. The course was designed for undergraduate students with variety of nationality, which introduced new technology development and achievements of Taiwan industries and research institutes from a historical approach. The contents included integrated circuit related industry, display industry, computer and information technology industry, nano and biomedical technology, agriculture and ecological research, and traditional industry transformation development in Taiwan that all have significant achievements in the world. During each class meeting, one or two technological topics were lectured accompanied with a 30-minutes multimedia video that presented relevant contents to enhance students understanding of the issues. All the videos were also mounted onto the course website for students to review after class.

Instrument

This study developed a questionnaire in order to realize the effectiveness of applying multimedia in supporting instruction and learning in a general engineering education course. There are three sections in the questionnaire: personal information includes gender, nationality, specialty; students' experience of watching videos in support their learning; students' attitude toward video-assist learning. For the attitude survey, the 6 point Likert-type scale was adopted for evaluation.

Data collection and Analysis

The questionnaire was administered to all students on the final class meeting of the course. Besides, this study used

Statistic Package of Social Science (SPSS 14.0) for descriptive analysis and ANOVA analysis.

Result

Subjects

Subjects of this study consisted of 54 undergraduate students registered in the general engineering education course "Scientific Taiwan" with valid returns of questionnaires. Of the total 54 subjects participating in this research, 45 were males (83.3%) and 9 were females (16.7%); and about one-third (31.5%) of them were foreign students from different countries. Besides, the students were from different departments with various majors; most of them claimed their specialty in bio-resources and agriculture (40.7%), as well as public health (31.5%). (See Table1)

Variable	Frequency	Percentage
Gender		
Female	45	83.3%
Male	9	16.7%
Nationality		
Taiwanese	37	68.5%
Foreigner	17	31.5%
Specialty*		
Bio-Resource and Agriculture	22	40.7%
Public health	17	31.5%
Law & Social Science	14	26.0%
Engineering	5	9.3%
Medicine	3	5.6%
Liberal art	3	5.6%
Science	1	1.9%

**Multiple-choice*

Students' Experiences of Watching Videos after Class

There were 17 students (31.5%) reported that they never watch video after class. For the rest 37 students, reasons for them to watch videos after class include they have to write class reports (44.4%); are interest in the lecture topics (27.8%); want to learn more information (20.4%); are used to review the contents learned in class (9.3%); and cannot follow up the class (3.7%). Researchers of this study tried to sort students with their learning engagement in terms of their video watching behavior, and categorized students into three groups: 13 students that actively want to learn more as positive learning group; 24 students for meeting assignment requirement as passive learning group; and those 17 students who never watched videos after class as none learning group. (See Table2)

Table 2 Students' experience of watching videos after class (N=54)

Variable	Frequency	Percentage
Watching videos after class		
Yes	37	78.5%
No	17	31.5%
Reason for watching videos after class*		
Interested in the lecture topics	15	27.8%
Have to write class reports	24	44.4%
Want to learn more information	11	20.4%
Cannot follow up the class	2	3.7%
Used to review the contents learned in class	6	9.3%
Learning engagement for watching videos		
Positive learning	13	24.1%
Passive learning	24	44.4%
None learning	17	31.5%

**Multiple-choice*

Students' Attitudes toward Video-assisted Instruction

This study tried to investigate students' attitude toward video-assisted instruction, results showed that they thought the video can help improve my understanding of contents (M=5.19, SD=1.01) and the depth of their learning (M=5.13, SD=0.991) of this course. They also thought the video can help arouse their awareness of learning issues in this area (M=5.00, S.D=1.18). Students also reported their preference of video-assisted learning. They liked this approach of using video to assist instruction and learning (M=5.17, SD=1.077) and also thought this approach of using video is better than traditional one (M=5.19, SD=1.011). Moreover, they would recommend this course to my classmates in the future (M=4.93, SD=1.226). Results of students' attitudes toward video-assisted learning analysis confirmed the effectiveness of using videos in support of instruction and learning in this general engineering education course.

Table 3 Students' attitudes toward video-assisted learning (N=54)

Items	Means	SD
I think the video can help improve my understanding of contents of this course.	5.19	1.01
I think the video can help arouse my awareness of learning issues in this area.	5.00	1.18
I think the video can help improve the depth of my learning in this course.	5.13	0.991
I like this approach of using video to assist instruction and learning.	5.17	1.077
I think this approach of using video is better than traditional instruction.	5.19	1.011
I will recommend this course to my classmates.	4.93	1.226

Students' Learning Engagement on Their Attitudes towards Video-assisted Learning

In order to examine whether students' learning engagement of watching videos after class would have impacts on their attitudes toward video-assisted learning, this study conduct one-way ANOVA analysis at the 0.05 level to test the effect. Results found that some of the items do show significant differences among the three learning groups (positive, passive, and none learning), including students' perceptions of video-assist instruction can help arouse personal awareness of learning issues in this area, as well as their views of this approach can improve the depth of their learning in this course.

To further examine the differences among the three groups, the Scheffe's method was conducted as the post hoc com-

parison method. Results showed that there was significant difference between positive learning and the passive learning groups; students of the former group perceived highly that the video can help arouse their awareness of learning issues in this area than those of the latter group. Besides, students' of the passive learning group perceived more about the video can improve the depth of their learning in this course than students who never watch videos after class.

Conclusions

This study intends to explore the effectiveness of applying multimedia in general engineering education in support of students' learning. Results confirmed that students thought the video can helped them improve learning in general and in specific learning issues. They all liked this approach of using video to assist instruction and learning, and preferred this approach over the traditional instruction. They also showed their willingness of recommending this course to peers. On the other hand, this study also found that students' degree of learning engagement would cause the variance of their perceived helpfulness of video-assisted learning in the general engineering education course. Based on the results found in this study, we proposed that engineering educators should be aware that students' engagement could affect their attitude toward learning and should be careful about designing learning activities including using multimedia in support of learning. Besides, the future research could try to explore more about students' characteristics in learning with multimedia, such as learning styles, abilities, and language proficiency. Results of this study should contribute to both engineering education practice and the future research.

Table 4 ANOVA table for students' motivation on attitudes toward video-assisted learning

	Sources	SS	MS	F-value	P-value	Post hoc test (Scheffe' method)
I think the video can help improve my understanding of contents of this course.	Between Groups	4.456	2.228	2.287	.112	
	Within Groups	49.692	.974			
	Total	54.148				
I think the video can help arouse my awareness of learning issues in this area.	Between Groups	11.864	5.932	4.869	.012*	Positive > Passive
	Within Groups	62.136	1.218			Mean difference=1.115*)
	Total	74.000				
I think the video can help improve the depth of my learning in this course.	Between Groups	7.383	3.692	4.211	.020*	Passive > None
	Within Groups	44.709	.877			(Mean difference =0.777**)
	Total	52.093				
I like this approach of using video to assist instruction and learning.	Between Groups	5.008	2.504	2.260	.115	
	Within Groups	56.492	1.108			
	Total	61.500				
I think this approach of using video is better than traditional instruction.	Between Groups	2.451	1.225	1.209	.307	
	Within Groups	51.698	1.014			
	Total	54.148				

I will recommend this course to my classmates.	Between Groups	1.035	.517	.335	.717	
	Within Groups	78.669	1.543			
	Total	79.704				

Note: *p<0.05

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